Arizona Mathematics Standard Articulated by Grade Level

GRADE 2

Every student should understand and use all concepts and skills from the previous grade levels. The standard is designed so that new learning builds on preceding skills. Communication, Problem-solving, Reasoning & Proof, Connections, and Representation are the process standards that are embedded throughout the teaching and learning of all mathematical strands.

Strand 1: Number and Operations

Number sense is the understanding of numbers and how they relate to each other and how they are used in specific context or real-world application. It includes an awareness of the different ways in which numbers are used, such as counting, measuring, labeling, and locating. It includes an awareness of the different types of numbers such as, whole numbers, integers, fractions, and decimals and the relationships between them and when each is most useful. Number sense includes an understanding of the size of numbers, so that students should be able to recognize that the volume of their room is closer to 1,000 than 10,000 cubic feet. Students develop a sense of what numbers are, i.e., to use numbers and number relationships to acquire basic facts, to solve a wide variety of real-world problems, and to estimate to determine the reasonableness of results.

Concept 1: Number Sense

Understand and apply numbers, ways of representing numbers, and the relationships among numbers and different number systems.

In Grade 2, students refine their understanding of the base ten number system and use place value concepts of ones, tens, and hundreds to understand number relationships. They become fluent in writing and renaming numbers in a variety of ways. This fluency, combined with the understanding of place value, is a strong foundation for learning how to add and subtract two-digit numbers.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Express whole numbers 0 to 1000, in groups of hundreds, tens and ones using and connecting multiple representations. Connections: M02-S1C1-02, M02-S1C1-03, M02-S1C1-04, M02-S1C1-05, M02-S1C1-06, M02-S2C1-01, M02-S2C1-02,	M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.	There is a strong connection between this performance objective and recording equivalent forms of whole numbers (M02-S3C3-01). Teaching these ideas concurrently is critical. Models, pictures, number lines, spoken and written words, and expanded form should be used. Continued on next page

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Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
M02-S2C3-01, M02-S2C3-02, M02-S3C3-01, M02-S4C4-01, M02-S4C4-02		Students identify digits and the values within a number. Example: • The number 458 has the following characteristics: o The digit in the hundreds place is 4 and has a value of 400, o the digit in the tens place is 5 and has a value 50, and o the digit in the ones place is 8 and has a value of 8.
PO 2. Count forward to 1000 and backward from 1000 by 1s, 10s, and 100s using different starting points. Connections: M02-S1C1-01, M02-S1C1-04, M02-S1C2-06, M02-S1C3-01, M02-S2C1-01, M02-S2C1-02, M02-S2C3-01, M02-S2C3-02, M02-S3C3-01, M02-S4C4-01, M02-S4C4-02, M02-S4C4-03		Counting includes counting aloud, finding missing numbers in a sequence, and finding missing numbers on a number line. Examples: • Count backwards from 504 to 487. "Start at 504. Count backward. I'll tell you when to stop." [Stop when the student has counted backward to 487.] • "Start at 248. Count up by 10s. I'll tell you when to stop." [Stop when the student has counted to 348 by 10s.]
PO 3. Identify numbers which are 100 more or less than a given number to 900. Connections: M02-S1C1-01, M02-S1C3-01	M02-S5C2-05. Explain and clarify mathematical thinking.	Examples: • 100 more than 653 is 753 (one more hundred), and • 100 less than 653 is 553 (one less hundred).

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 4. Compare and order whole numbers through 1000 by applying the concept of place value. Connections: M02-S1C1-01, M02-S1C1-02, M02-S3C3-02	M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols. M02-S5C2-05. Explain and clarify mathematical thinking.	There is a strong connection between this performance objective and representing numbers (M02-S3C3-02). Teaching these ideas concurrently is critical. Students use models, pictures, number lines, or spoken and written words to compare or order numbers. They use comparative language and symbols (<, >, = , ≠). The words *equal to, greater than, less than, greatest* or *least* are used when appropriate.
PO 5. Count money to $1.00. Connections: M02-S1C1-01, M02-S1C2-01, M02-S1C2-02		Skills expected in counting money include identifying coins, finding the value of a collection of coins, using multiple ways to represent a given amount, and using symbols to represent amounts both ways ($ and decimal or ¢). Example: • 56 cents can be written as 56¢ or $0.56. Note that students need to read the latter as zero dollars and 56 cents.
PO 6. Sort whole numbers through 1000 into odd and even, and justify the sort. Connections: M02-S1C1-01, M02-S1C2-01	M02-S5C2-05. Explain and clarify mathematical thinking.	Students explore odd and even numbers in a variety of ways including the following: • For smaller numbers, students may investigate if a number is odd or even by determining if that number of objects can be divided into two equal sets OR arranged into pairs. • For larger numbers, students may use reasoning to determine odd or even (e.g., for the number 843, students can reason that 800 can be split into two groups of 400, 40 can be split into two groups of 20, and 3 can be split into two groups of 1 with 1 left-over. Because there is a left-over, the number is odd. After the above experiences, students may derive that they only need to look at the digit in the ones place to determine if a number is odd or even since any number of tens and hundreds will always split into two even groups.

Strand 1: Number and Operations
Concept 2: Numerical Operations

Understand and apply numerical operations and their relationship to one another.

In Grade 2, students continue to focus on what it means to add and subtract as they become fluent with single-digit addition and subtraction facts and develop addition and subtraction procedures for two-digit numbers. Students make sense of these procedures by building on what they know about place value, number relationships, and putting together or taking apart sets of objects. They begin to develop an understanding of multiplication.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Solve contextual problems using multiple representations involving • addition and subtraction with one- and/or two-digit numbers, • multiplication for 1s, 2s, 5s, and 10s, and • adding and subtracting money to $1.00. Connections: M02-S1C1-05, M02-S1C1-06, M02-S1C2-02, M02-S1C2-03, M02-S1C2-04, M02-S1C2-05, M02-S1C2-06, M02-S1C2-08, M02-S2C1-02, M02-S2C3-01, M02-S2C3-02, M02-S3C1-01, M02-S3C1-02, M02-S3C2-01, M02-S3C3-03, M02-S4C4-02	M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution. M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols. M02-S5C2-06. Determine whether a solution is reasonable.	There is a strong connection between this performance objective and representing word problems requiring addition or subtraction through 100 in an equation (M02-S3C3-03). Teaching these ideas concurrently is critical. In Grade 2, contextual problems are usually word problems that help develop and apply the concepts and skills taught in all the mathematics strands including number sense, operations, data analysis, patterns, algebra, geometry, and measurement. Students use the symbols +, -, x, and = to record number sentences. The word problems should include all addition, subtraction, and multiplication skills listed in the performance objective. Students use a variety of representations including numbers, pictures, objects, and words to model their solutions.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 2. Demonstrate the ability to add and subtract whole numbers (to at least two digits) and decimals (in the context of money) • with up to three addends and • to $1.00. Connections: M02-S1C1-05, M02-S1C2-01, M02-S1C2-03, M02-S1C2-05, M02-S1C2-07, M02-S1C2-08, M02-S1C3-01, M02-S2C1-02, M02-S3C1-01, M02-S3C1-02, M02-S3C2-01, M02-S3C3-02, M02-S3C3-04	M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.	Students demonstrate addition and subtraction using many different models including manipulatives, pictures, diagrams, words, and numbers. They demonstrate addition and subtraction with one- and/or two-digit numbers either with or without regrouping.
PO 3. Demonstrate fluency of addition and subtraction facts. Connections: M02-S1C2-01, M02-S1C2-02, M02-S1C2-04, M02-S1C2-08, M02-S2C3-02, M02-S3C2-01, M02-S3C3-02, M02-S3C3-03, M02-S3C3-04		There is a strong connection between this performance objective and identifying the value of an unknown number in an equation involving an addition or subtraction fact (M02-S3C3-04). Teaching these ideas concurrently is critical. Continued on next page

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
		Students demonstrate fluency with addition facts through 10 + 10 and the related subtraction facts. Fact fluency includes working with facts flexibly, accurately, and efficiently. This means that students have quick recall using strategies that are efficient. First-grade strategies which may be reviewed and will lead to quick recall include: • 0, 1, or 2 more/less than • Counting on • Counting back • Making tens • Adding nine using "plus 10, minus 1" • Using doubles • Using near doubles(Ex: 5 + 6 is 5 + 5 plus 1 more) • Using commutativity • Subtracting by counting up (Ex: 8 – 3. Count up from 3, that is, 4, 5, 6, 7, 8) These strategies should be developed until students use them both accurately and efficiently.
PO 4. Apply and interpret the concept of addition and subtraction as inverse operations to solve problems. Connections: M02-S1C2-01, M02-S1C2-03, M02-S3C3-03	M02-S5C2-05. Explain and clarify mathematical thinking.	Fact families demonstrate the inverse operations of addition and subtraction by listing the four possible facts using the same three numbers. Students demonstrate this relationship using physical models, diagrams, numbers, or acting-out situations. Example: • The fact family for 3, 5, and 8 includes the following four facts: o 3 + 5 = 8 o 5 + 3 = 8 o 8 – 3 = 5 o 8 – 5 = 3

Arizona Mathematics Standard Articulated by Grade Level

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 5. Create and solve word problems based on addition and subtraction of two-digit numbers. Connections: M02-S1C2-01, M02-S1C2-02, M02-S2C1-02, M02-S3C3-03	M02-S5C2-01. Identify the question(s) asked and any other questions that need to be answered in order to find a solution. M02-S5-C2-02. Identify the given information that can be used to find a solution.	There is a strong connection between this performance objective and representing word problems requiring addition or subtraction through 100 in an equation (M02-S3C3-03). Teaching these ideas concurrently is critical. A second grade word problem includes two parts (the information and the question), and should not reveal the "answer." Students create written word problems which apply the addition and subtraction skills covered in the previous two performance objectives.
PO 6. Demonstrate the concept of multiplication for 1s, 2s, 5s, and 10s. Connections: M02-S1C1-02, M02-S1C2-01, M02-S2C1-01, M02-S2C1-02, M02-S3C1-01, M02-S3C1-02, M02-S3C2-01	M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.	Students build on their experiences of skip counting by 2s, 5s, and 10s to develop understanding of multiplication by these numbers. Objects and pictures should be used so that students can recognize that 5, 10, 15 and 20 can be represented as 1 group of 5 (5), 2 groups of 5 (10), 3 groups of 5 (15), etc. These ideas should first be recorded as "2 groups of 5 is 10" before writing 2 x 5 = 10. In addition to using skip counting, repeated addition, and equal groups, students demonstrate multiplication by creating arrays.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 7. Describe the effect of operations (addition and subtraction) on the size of whole numbers. Connections: M02-S1C2-02	M02-S5C2-05. Explain and clarify mathematical thinking.	The effect of operations on the size of a number is not consistent between whole numbers and the real number system. Students should be made aware that the patterns they observe when adding and subtracting will not always be true. Examples: • Adding whole numbers causes the quantity to increase. Subtracting whole numbers causes the quantity to decrease. It is important to note that this is true for whole numbers, but not necessarily for all numbers. • Within the whole number system one cannot subtract a larger number from a smaller number, but this will not always be the case (4 – 6 = -2).
PO 8. Apply properties to solve addition/subtraction problems • identity property of addition/subtraction, • commutative property of addition, and • associative property of addition. Connections: M02-S1C2-01, M02-S1C2-02, M02-S1C2-03	M02-S5C2-05. Explain and clarify mathematical thinking.	

Strand 1: Number and Operations
Concept 3: Estimation

Use estimation strategies reasonably and fluently while integrating content from each of the other strands.

In Grade 2, students use the benchmark numbers 20, 50, and 100 to estimate sums without rounding.

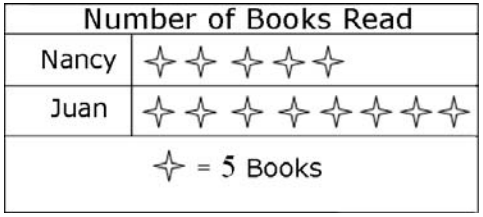
Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Use estimation to determine if sums of two 2-digit numbers are more or less than 20, more or less than 50, or more or less than 100. Connections: M02-S1C1-02, M02-S1C1-03, M02-S1C2-02, M02-S2C1-01, M02-S2C1-02	M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution. M02-S5C2-06. Determine whether a solution is reasonable.	In Grade 2, students are not expected to estimate by rounding. However, they are expected to examine two numbers being added and determine if the sum will be more/less than 20, 50, or 100. Example: 23 + 58 (possible thinking) • The sum is more than 50 because I am adding another number to 58. • The sum is less than 100 because 100 is 10 tens and 23 + 58 is a little more than 7 tens.

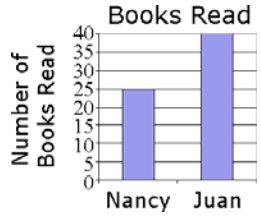
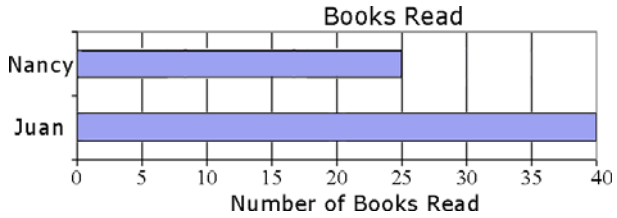
Strand 2: Data Analysis, Probability, and Discrete Mathematics
This strand requires students to use data collection, data analysis, statistics, probability, systematic listing and counting, and the study of graphs. This prepares students for the study of discrete functions as well as to make valid inferences, decisions, and arguments. Discrete mathematics is a branch of mathematics that is widely used in business and industry. Combinatorics is the mathematics of systematic counting. Vertex-edge graphs are used to model and solve problems involving paths, networks, and relationships among a finite number of objects.

Concept 1: Data Analysis (Statistics)

Understand and apply data collection, organization, and representation to analyze and sort data.

In Grade 2, students create displays of data and ask and answer questions about data as they apply their growing understanding related to numbers and the operations of addition, subtraction, and multiplication.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Collect, record, organize, and display data using pictographs, frequency tables, or single bar graphs. Connections: M02-S1C1-01, M02-S1C1-02, M02-S1C2-06, M02-S1C3-01, M02-S2C1-02, SC02-S1C2-04, SC02-S1C3-01, SS02-S4C1-04, SS02-S4C6-02	M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.	**Examples:** • **Pictographs**: In Grade 2, pictographs include symbols that represent multiple units. Pictographs with a symbol that represents a single unit were addressed in grade 1. Below is an example of a pictograph with symbols that represent multiple units. Pictographs should include a title, categories, category label, key, and data.  Continued on next page

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
		• **Frequency Tables**: Below is an example of a frequency table. A frequency table may or may not include a column for tallies. Number of Books Read Person | Tally | Total Nancy | 𝍸 𝍸 𝍸 𝍸 | 25 Juan | 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 | 40 • **Single Bar Graphs**: Students should use both horizontal and vertical bar graphs. Bar graphs include a title, scale, scale label, categories, category label, and data.  

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 2. Formulate and answer questions by interpreting displays of data, including pictographs, frequency tables, or single bar graphs. Connections: M02-S1C1-01, M02-S1C1-02, M02-S1C2-01, M02-S1C2-02, M02-S1C2-05, M02-S1C2-06, M02-S1C3-01, M02-S2C1-01, SC02-S1C1-01, SC02-S1C3-01, SS02-S4C6-02	M02-S5C2-01. Identify the question(s) asked and any other questions that need to be answered in order to find a solution. M02-S5C2-02. Identify the given information that can be used to find a solution.	Students explain a given/created display of data using statements that include comparative language. Students ask quantitative and/or comparative questions based on a given/created display of data either orally or in writing. They also answer questions using a given/created display of data.

Strand 2: Data Analysis, Probability, and Discrete Mathematics
Concept 2: Probability

Understand and apply the basic concepts of probability.

In Grade 2, there are no performance objectives in this concept. Performance objectives begin in Grade 3.

Strand 2: Data Analysis, Probability, and Discrete Mathematics
Concept 3: Systematic Listing and Counting

Understand and demonstrate the systematic listing and counting of possible outcomes.

In Grade 2 students apply their number sense skills to solve contextual problems involving systematic listing and counting.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. List all possibilities in counting situations. Connections: M02-S1C1-01, M02-S1C1-02, M02-S1C2-01	M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution.	In Grade 2, students randomly list all possibilities and begin to organize their results by answering the question, "How do you know you have them all?" Students create all possibilities using concrete materials whenever possible, so children can move around the objects to organize them. Examples: • Show all the ways to build a tower using three blocks (red, yellow, and blue). – RYB, RBY, YRB, YBR, BRY, BYR. How many did you find? • Draw the number of outfits that you can make using 4 different shirts (red, blue, green, & white) and 2 different pairs of shorts (black & brown)? How many did you find? [answer: 8 outfits] • List all pairs of numbers whose sum is 15. How do you know you have them all? • If you have 25 cents in your pocket, what are some possible coins you could have in your pocket?

<table>
<tr><th>Performance Objectives</th><th>Process Integration</th><th>Explanations and Examples</th></tr>
<tr><td>Students are expected to:</td><td></td><td></td></tr>
<tr><td>PO 2. Solve a variety of problems based on the addition principle of counting.

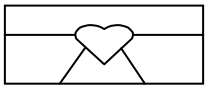
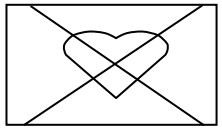
Connections: M02-S1C1-01, M02-S1C1-02, M02-S1C2-01, M02-S1C2-03, M02-S3C1-01, M02-S3C3-03</td><td>M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution.</td><td>Examples:
Mrs. Akers asked all 98 students in second grade to vote for their favorite fruit. They could choose either apples or bananas. The results of the vote are shown in the chart below.<table><tr><th colspan="3">Votes for Favorite Fruit</th></tr><tr><th></th><th>Apples</th><th>Bananas</th></tr><tr><td>Number of Boys</td><td>30</td><td>15</td></tr><tr><td>Number of Girls</td><td>28</td><td>25</td></tr></table>How many boys voted? How many girls voted? How many students chose apples as their favorite fruit? How many students chose bananas as their favorite fruit? How many students did not choose bananas?
Sally has 15 pink t-shirts. Three of her pink t-shirts have butterflies on them. How many of her pink t-shirts don’t have butterflies on them?</td></tr>
</table>

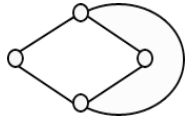
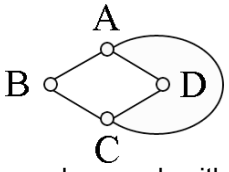
Strand 2: Data Analysis, Probability, and Discrete Mathematics
Concept 4: Vertex-Edge Graphs

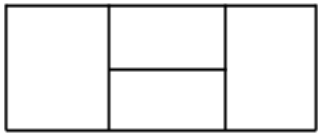
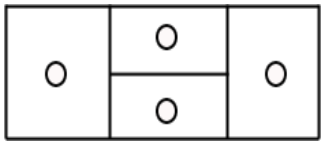
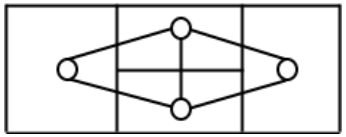
Understand and apply vertex-edge graphs.

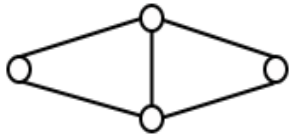
In Grade 2, students apply problem solving skills to color simple pictures/maps following specific rules and to create vertex-edge graphs using concrete materials or drawings. The ideas introduced in second grade are extended to more complex situations in the grades that follow.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Color simple pictures or maps using the least number of colors and justify the coloring.	M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution. M02-S5C2-05. Explain and clarify mathematical thinking.	Students are introduced to the ideas of coloring simple pictures and maps using a minimum number of colors. Any two regions that share a border must be colored using different colors. Two regions that meet at one point do not share a border, and thus may be colored using the same color. Many students believe a point is not considered an edge. Realizing that a point is not an edge does not happen without exploration and discussion. Students should have multiple opportunities to color a variety of simple pictures and maps. The goal is for students to use the fewest number of colors; some possible strategies that young children may use include a guess-and-check strategy, use many colors and try to eliminate one color at a time; or use few colors and insert another color when necessary. Some students may begin to notice patterns as they explore different pictures/maps. They should be encouraged to make conjectures and support their conjectures with examples. Students are expected to justify their coloring with explanations and evidence. Continued on next page

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
		Examples: • Use clip art, coloring pages, cookie cutter outlines, or self-drawn pictures for students to count and color the regions. You may want to have students use small colored counters or colored paper/foam shapes that they can move around to change colors as a first step prior to using crayons or other more permanent coloring tools. Be sure you have 8-10 colors available. This will allow students flexibility to change their coloring as they attempt to use fewer colors. • The picture below has five regions and can be colored using three colors.  • This next picture has eight regions and can be colored using two colors.  Discuss with students different strategies they used to find the fewest number of colors. In the end, a justification includes the number of colors and visual proof that it has been done.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 2. Build vertex-edge graphs using concrete materials and explore simple properties of vertex-edge graphs • number of vertices and edges, • neighboring vertices, and • paths in a graph. Connections: M02-S2C4-03		A vertex-edge graph is a collection of vertices and edges. A vertex is a point/dot that represents an object or location. An edge connects two vertices and represents some relationship between them. The vertex-edge graph below has 4 vertices and 5 edges.  A vertex-edge graph may be constructed using concrete materials to represent vertices and edges. Concrete materials to represent vertices may include colored counters, marshmallows, raisins, dot stickers, colored paper circles, paper plates, etc. Concrete materials to represent edges may include toothpicks, yarn, pipe cleaners, pretzels, straws, masking tape, etc.  After creating a vertex-edge graph with concrete materials, students should count and record the number of vertices and edges. They should also discuss neighboring vertices and explore different paths in graphs. A vertex is a neighbor to another vertex if they share an edge. In the example above, A is a neighbor to B, C, and D; while B and D are NOT neighbors. A path in a graph is a connected sequence of edges that starts at a vertex and ends at a vertex. Usually you describe a path by naming the sequence of vertices in the path. For example, D-A-C-B is a path that starts at vertex D, goes to vertex A, then vertex C, and ends at vertex B.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 3. Construct simple vertex-edge graphs from simple pictures or maps. Connections: M02-S2C4-02	M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.	Students are introduced to the connection between coloring pictures/maps and vertex-edge graphs. This introduction will lead to using vertex-edge graphs to solve problems (conflict resolution, shortest path, minimum spanning tree, etc.) in future grade levels. The example below shows the progression of creating a vertex-edge graph from a simple picture or map. 1. Select a simple picture or map.  2. Draw a vertex inside each region. (Suggestion – lay a clear transparency or tracing paper over the picture or map on which to draw the vertex-edge graph).  3. Draw an edge to connect two vertices together if they are located inside regions that share a border.  Continued on next page

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
		4. Remove the simple picture or map to view the vertex-edge graph that represents it.  Students should be able to identify that each vertex represents a region and that an edge is drawn between two vertices that share a border. The progression described above may also be accomplished by producing a poster size copy of a simple figure/map. A vertex could be represented by placing a large paper circle inside each region of the figure/map and edges could be represented by placing pieces of yarn/thin strips of paper between two vertices that should be connected. Students can replicate this process using individual pictures and materials or as a group with poster size versions of the picture/map.

Strand 3: Patterns, Algebra, and Functions
Patterns occur everywhere in nature. Algebraic methods are used to explore, model and describe patterns, relationships, and functions involving numbers, shapes, iteration, recursion, and graphs within a variety of real-world problem solving situations. Iteration and recursion are used to model sequential, step-by-step change. Algebra emphasizes relationships among quantities, including functions, ways of representing mathematical relationships, and the analysis of change.

Concept 1: Patterns

Identify patterns and apply pattern recognition to reason mathematically while integrating content from each of the other strands.

In Grade 2, students work with patterns to extend their thinking about numbers, operations, and geometry and use reasoning to describe the patterns and their rules.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Recognize, describe, extend, create, and find missing terms in a numerical or symbolic pattern. Connections: M02-S1C2-01, M02-S1C2-02, M02-S1C2-06, M02-S2C3-02, M02-S3C1-02, M02-S3C2-01, M02-S4C4-04	M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution. M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.	Patterns involving numbers or symbols either repeat or grow. Students in K-1 have had many experiences with repeating patterns. In Grade 2, students should experience growth patterns that increase or decrease by applying the same process over and over. Numerical patterns allow students to reinforce facts and develop fluency with operations. Examples: • numerical patterns: o 3, 8, 13, 18, 23, 28, …(applies "+5" over and over) o 5, 50, 500, … o 7, 14, 21, …(converting 1, 2, 3 weeks to days) • symbolic patterns: o AABC, AABBC, AABBBC, …

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 2. Explain the rule for a given numerical or symbolic pattern and verify that the rule works. Connections: M02-S1C2-01, M02-S1C2-02, M02-S1C2-06, M02-S3C1-01, M02-S3C2-01	M02-S5C2-05. Explain and clarify mathematical thinking.	

Strand 3: Patterns, Algebra, and Functions
Concept 2: Functions and Relationships

Describe and model functions and their relationships.

In Grade 2, students extend their understanding of patterns as they explore the relationships between sets of numbers using objects, pictures, and function tables.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Describe a rule that represents a given relationship between two quantities using words or pictures. Connections: M02-S1C2-01, M02-S1C1-02, M02-S1C2-03, M02-S1C2-06, M02-S3C1-01, M02-S3C1-02	M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution. M02-S5C2-05. Explain and clarify mathematical thinking.	Patterns and functions are related. A pattern is a sequence that repeats the same process over and over. A function focuses on the relationship between two sets of numbers, and a function very often results in the creation of a pattern. Example: • The pattern 3, 6, 9, 12, 15, 18, … can be seen in a function that compares the relationship between the number of triangles and the number of sides they have. Rule: There are 3 sides for each triangle.

Triangles	1	2	3	4	5	6
Sides	3	6	9	12	15	18

Strand 3: Patterns, Algebra, and Functions
Concept 3: Algebraic Representations

Represent and analyze mathematical situations and structures using algebraic representations.

In Grade 2, students make strong connections between algebraic representations and number sense. These connections lay the foundation for future work with larger numbers and algebra.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Record equivalent forms of whole numbers to 1000 by constructing models and using numbers. Connections: M02-S1C1-01, M02-S1C2-02	M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.	There is a strong connection between this performance objective and representing numbers (M02-S1C1-01). Teaching these ideas concurrently is critical. Students should have opportunities to build and draw several representations of a given number and record several mathematical expressions for that number. Example: • Some equivalent expressions for 68 are o 30 + 30 + 8 o 10 + 10 + 20 + 20 + 5 + 3 o 70 - 2
PO 2. Compare expressions using spoken words and the symbols =, ≠, <, and >. Connections: M02-S1C1-04, M02-S1C2-02, M02-S1C2-03	M02-S5C2-05. Explain and clarify mathematical thinking.	There is a strong connection between this performance objective and comparing and ordering numbers (M02-S1C1-04). Teaching these ideas concurrently is critical. Students need to understand that *equality* means *the same quantity as* and should be able to explain why one expression is equal to or not equal to another expression. If expressions are not equal students need to determine which is greater or smaller. They do not always have to compute in order to compare expressions. They can often look at the relationship between the numbers in the expressions to make a comparison and should be able to explain their reasoning. Continued on next page

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
		Examples: • 5 + 4 is not equal to 4 + 3 (because the 5 + 4 has to be more than 4 + 3 since 4 is the same quantity in both and 5 is larger than 3). • 15 + 25 < 60 – 10 (because adding 25 to 15 will give a smaller number than subtracting 10 from 60. • 36 + 52 = 35 + 53 (because if you take 1 from the 36 and give it to the 52 you will get the expression on the right).
PO 3. Represent a word problem requiring addition or subtraction through 100 using an equation. Connections: M02-S1C2-01, M02-S1C2-03, M02-S1C2-04, M02-S1C2-05, M02-S2C3-02	M02-S5C2-04. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.	There is a strong connection between this performance objective and solving and creating contextual problems (M02-S1C2-01 and M02-S1C2-05). Teaching these ideas concurrently is critical. Equations include: • $a + b = \square$, • $c - a = \square$, • $a + \square = c$, • $c = a + \square$, • $c = \square + b$. • $\square + b = c$, • $c - \square = b$, and • $\square - a = b$. Example: • A word problem for $\square - a = b$ may be Chris had some cards and gave 26 to his brother. Now he has 18. How many did he have to start with?

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 4. Identify the value of an unknown number in an equation involving an addition or subtraction fact. Connections: M02-S1C2-02, M02-S1C2-03	M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution.	There is a strong connection between this performance objective and demonstrating fluency of addition and subtraction facts (M02-S1C2-03). Addition facts through 10 + 10 and the related subtraction facts should be included. Teaching these ideas concurrently is critical. Students need experience with equivalence to accompany their first work with addition and subtraction. Flexible use of equivalence and missing numbers sets the stage for later work when solving equations where the variable is in different positions. Students can determine the unknowns by computing or using reasoning after examining the relationship between the numbers. Examples: • 9 + 2 = ___ + 5 (I think 5 + 4 + 2 = __ + 5, so the __ must be 6.) • 10 – 7 = 2 + ___ (I think 8 + 2 – 7 = 2 + __ , so the problem is really 8 - 7 so the __ is 1.) • ___ = 9 + 4 + 2

Strand 3: Patterns, Algebra, and Functions
Concept 4: Analysis of Change

Analyze how changing the values of one quantity corresponds to change in the values of another quantity.

In Grade 2, there are no performance objectives in this concept. Performance objectives begin in Grade 4.

Strand 4: Geometry and Measurement

Geometry is a natural place for the development of students' reasoning, higher thinking, and justification skills culminating in work with proofs. Geometric modeling and spatial reasoning offer ways to interpret and describe physical environments and can be important tools in problem solving. Students use geometric methods, properties and relationships, transformations, and coordinate geometry as a means to recognize, draw, describe, connect, analyze, and measure shapes and representations in the physical world. Measurement is the assignment of a numerical value to an attribute of an object, such as the length of a pencil. At more sophisticated levels, measurement involves assigning a number to a characteristic of a situation, as is done by the consumer price index. A major emphasis in this strand is becoming familiar with the units and processes that are used in measuring attributes.

Concept 1: Geometric Properties

Analyze the attributes and properties of 2- and 3- dimensional figures and develop mathematical arguments about their relationships.

In Grade 2, students extend their spatial understanding of geometry developed in kindergarten and Grade 1 by solving problems involving two-dimensional figures.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Describe and compare the attributes of polygons up to six sides using the terms side, vertex, point, and length. Connections: M02-S4C2-01	M02-S5C2-05. Explain and clarify mathematical thinking.	Students identify, describe, and compare triangles, rectangles (including squares), pentagons, and hexagons. They also describe and compare other quadrilaterals but not necessarily name them. Pentagons and hexagons should appear as both regular (equal sides and equal angles) and irregular.

Strand 4: Geometry and Measurement
Concept 2: Transformation of Shapes

Apply spatial reasoning to create transformations and use symmetry to analyze mathematical situations.

In Grade 2, students explain the rationale for symmetry of two-dimensional figures.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Identify, with justification, whether a 2-dimensional figure has lines of symmetry. Connections: M02-S4C1-01	M02-S5C2-05. Explain and clarify mathematical thinking.	Students need experiences with figures which are symmetrical and non-symmetrical. Folding cut-out figures will help students determine whether a figure has one or more lines of symmetry and help them justify their ideas.

Strand 4: Geometry and Measurement
Concept 3: Coordinate Geometry

Specify and describe spatial relationships using rectangular and other coordinate systems while integrating content from each of the other strands.

In Grade 2, there are no performance objectives in this concept. Performance objectives begin in Grade 4.

Strand 4: Geometry and Measurement
Concept 4: Measurement

Understand and apply appropriate units of measure, measurement techniques, and formulas to determine measurements.

In Grade 2, students understand the process of measuring length and progress from measuring length with nonstandard units to using standard units. They use tools such as rulers, tape measures, or meter sticks. Students are well acquainted with two-digit numbers by this point and are able to tell time on different types of clocks.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:		
PO 1. Tell time to the nearest minute using analog and digital clocks. Connections: M02-S1C1-01, M02-S1C1-02, M02-S4C4-04		
PO 2. Apply measurement skills to measure the attributes of an object (length, capacity, weight). Connections: M02-S1C1-01, M02-S1C1-02, M02-S1C2-01, SC02-S1C2-03, SC02-S5C1-01	M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution.	Measurement skills include: • name measureable attributes of the object, • select an appropriate attribute to measure, • select an appropriate unit of measure (inch, foot, ounce, pound, cup, or quart), • select an appropriate tool, • estimate, • measure, and • compare estimate to actual measure.
PO 3. Read temperatures on a thermometer using Fahrenheit and Celsius. Connections: M02-S1C1-02, SC02-S1C2-03, SC02-S6C3-01		

PO 4. Demonstrate unit conversions • 1 foot = 12 inches, • 1 quart = 4 cups, • 1 pound = 16 ounces, • 1 hour = 60 minutes, • 1 day = 24 hours, • 1 week = 7 days, and • 1 year = 12 months. Connections: M02-S3C1-01, M02-S4C4-01	M02-S5C2-02. Identify the given information that can be used to find a solution. M02-S5C2-03. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution.	Students describe relationships such as, "Since a minute is less than an hour, there are more minutes than hours in one day."

Strand 5: Structure and Logic

This strand emphasizes the core processes of problem solving. Students draw from the content of the other four strands to devise algorithms and analyze algorithmic thinking. Strand One and Strand Three provide the conceptual and computational basis for these algorithms. Logical reasoning and proof draws its substance from the study of geometry, patterns, and analysis to connect remaining strands. Students use algorithms, algorithmic thinking, and logical reasoning (both inductive and deductive) as they make conjectures and test the validity of arguments and proofs. Concept two develops the core processes as students evaluate situations, select problem solving strategies, draw logical conclusions, develop and describe solutions, and recognize their applications.

Concept 1: Algorithms and Algorithmic Thinking

Use reasoning to solve mathematical problems.

In Grade 2, there are no performance objectives in this concept. Performance objectives begin in Grade 4.

Strand 5: Structure and Logic
Concept 2: Logic, Reasoning, Problem Solving, and Proof

Evaluate situations, select problem-solving strategies, draw logical conclusions, develop and describe solutions, and recognize their applications.

In Grade 2, students have opportunities to "do" mathematics by solving problems and talking about what they did to solve those problems. Students communicate their mathematical thinking and make increasingly more convincing mathematical arguments.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:	Some of the Strand 5 Concept 2 performance objectives are listed throughout the grade level document in the Process Integration Column (2nd column). Since these performance objectives are connected to the other content strands, the process integration column is not used in this section next to those performance objectives.	
PO 1. Identify the question(s) asked and any other questions that need to be answered in order to find a solution.		
PO 2. Identify the given information that can be used to find a solution.		
PO 3. Select from a variety of problem-solving strategies and use one or more strategies to arrive at a solution.		Problem solving strategies may include drawing pictures, using objects, acting out, making a chart or list, etc.
PO 4. Represent a problem situation using any combination of words, numbers, pictures, physical objects, or symbols.		Students need opportunities to connect the different representations and explain the connections. Representations should include numbers, words (including mathematical language), pictures, and/or physical objects. Students should be able to use all of these representations as needed.

Performance Objectives	***Process Integration***	***Explanations and Examples***
Students are expected to:	Some of the Strand 5 Concept 2 performance objectives are listed throughout the grade level document in the Process Integration Column (2nd column). Since these performance objectives are connected to the other content strands, the process integration column is not used in this section next to those performance objectives.	
PO 5. Explain and clarify mathematical thinking.		Students often need to use objects and pictures to explain their thinking. Modeling different explanations to guide students is helpful.
PO 6. Determine whether a solution is reasonable.		